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Abstract

This paper was motivated by our limited understanding of the usefulness of Internet web sites as a learning support for different student profiles. The paper reports the findings of a study that examined differences in the use and perceptions of web-based learning support services between students demonstrating different learning styles. Based on a sample of 49 undergraduate business school students, the findings indicate that the students preferring hands on learning perceive as more useful administrative, groupware, and class preparation web site services than students that prefer analysis. The results have important implications for trainers and teachers involved in the design and implementation of web sites learning support systems.

Introduction

Web sites are more and more present in the classroom, supporting traditional instruction through discussion forums, syllabus information, interactive quizzes and lecture notes file downloads class notes. In 2000 almost one-third of all US college courses had a Web page (Green, 2000), representing a threefold increase from 1996 levels. Low levels of actual use, as well as motivation to use, class web sites have nonetheless been deplored by the literature (El-Tigi, 2000; Chandler and Maddux, 1998). These findings may be explained by web designs that inadequately support differences in student's approaches to learning.

The education literature suggests that the quality of learning material is enhanced if the material is designed to take into account student's individual learning styles (Rasmussen, 1998; Riding and Grimley, 1999). Adjusting teaching materials to meet the needs of a variety of learning styles is a key to getting and keeping students actively involved in learning (Dewar, 1995; Kramer-Koehler et al., 1995). For web site designers, a rich source of information on individual differences is the growing body of research on learning styles and strategies, which explains how individuals learn, process new knowledge and represent information.

While numerous studies have examined the role of learning styles in the appropriation of new learning technologies such as computer based training, distance learning (Morgan and Tam, 1999; Ozga and Sukhnanden, 1998), computer mediated learner-teacher communication, and learner-learner or learner-expert collaborative systems (Alavi, 1994), little attention has been paid to the acceptance of web site as a support for more traditional classroom based instruction.

This paper attempts to improve our understanding of the pedagogical contingencies in learning support web site design. The paper is organized as follows. The following section develops the theoretical framework and the hypothesis to be tested. Subsequent section address, in turn, variable measurement, methodology, results, discussion, limitations and directions for future research.

Theoretical Framework

This section first defines web site learning support and then describes the way in which both learning styles and the technology acceptance model and have been conceptualised. This is followed by the theoretical model and statement of hypothesis.

Web Site Learning Support

A web site is a collection of multimedia files interconnected through hypertext links that may be viewed through dedicated navigator software. Web services facilitate and encourage learner-teacher (FAQs, contact forms), learner-learner (groupware and discussion forums) and learner-content (online class preparation and lecture notes) interactions (Miller and Miller, 1999). For the purposes of this study, web services will be categorized as administrative (learner-teacher interaction), collaborative (learner-learner/expert interaction) or class preparation (learner-content interaction).

Learning Styles

Learning styles are the different ways that adults and children think and learn (Litzinger and Osif, 1992). The theory of learning that has received the most attention in the management education literature is that of Kolb (1976, 1984) (Allinson and Hayes, 1988). His model describes a four-stage cycle of learning through the acquisition of concrete experience, reflective observation on that experience, building of theory from that reflection and then the testing of that theory through active experimentation and new concrete experiences. A learner's preference for one or more stages of the cycle describes his or her learning style.

Kolb's theory was adopted for the present study as it has been found to be successfully implemented in learning contexts where experiential learning, or constructivism is an appropriate pedagogy (Leidner and Jarvenpaa, 1995). It is generally accepted that the integration of information and communication technologies in the classroom, and hypermedia and network technologies in particular (Leidner and Jarvenpaa, 1995), support a predominately constructivist model of learning (Larose et al., 1999).

Honey and Mumford (1982) developed Kolb's learning cycle concentrating on observable behaviour rather than the psychological basis for that behaviour so as to identify learning styles more meaningful for a managerial population (Allinson and Hayes, 1988). They describe four learning styles broadly equivalent to the four stages of Kolb's learning cycle. Activists learn by engaging wholeheartedly in new experiences, they appreciate all things new and are willing to try first and evaluate the consequences later. Reflectors learn by observing, collecting and analysing a wide quantity of information and weighing up different points of view before acting. Theorists learn through organising their observations into a conceptual framework, rationally analysing and synthesising information. Pragmatists learn through the practical application of theories and techniques, constantly seeking out new ideas to test and experiment.

Honey and Mumford (1992) measure learning styles by means of a self-description questionnaire, the Learning Style Questionnaire (LSQ), a relatively more reliable instrument than Kolb's equivalent Learning Style Inventory (Chevrier et al., 2000; Allinson and Hayes, 1988) and will be employed here. The ability of the instrument to correctly measure the four underlying dimensions has been questioned (Allinson and Hayes, 1988).

Technology Acceptance Model

Several theoretical models have been proposed to explain information system adoption and use, including innovation diffusion theory (Rogers, 1995), the theory of reasoned action (Ajzen and Fishbein, 1980), the theory of planned behaviour (Ajzen, 1991) and the widely accepted and empirically confirmed technology acceptance model (TAM) (Davis, 1989; Venkatesh and Davis, 2000).

The TAM theorizes that information system use is determined by an individual's perceptions of its potential to enhance job performance ("perceived usefulness") and its facility of use ("perceived ease of use") (Davis, 1989). Perceived ease of use should also positively influence user perceptions of system usefulness. The effects of external factors on system use, such as training and motivation, are mediated by perceived usefulness and perceived ease of use (Davis, 1989), although further research integrating external factors into the TAM is needed (Venkatesh and Davis, 2000).

In an educational context it would seem reasonable to assume that students choose the means to attain their scholastic objectives in a rational manner, preferring to use systems that that perceive as relatively useful and easy to use. For the purposes of this paper, the TAM is adopted as an appropriate explicative model of technology acceptance.

The Theoretical Model

According to a constructivist model of learning, class use of web technologies take on a pedagogical role especially when used to support course material concerned by the Internet, such as Internet Marketing (Kaynama and Keesling, 2000). In such a context web services are an instructional material that should be designed and adapted to different learning style profiles (McLouglin, 1999; Curry, 1995).

For activists and pragmatists the use of a class web site would represent the opportunity to acquire concrete experience and test concepts developed in a parallel traditional class environment. Theorists and reflectors on the other hand may prefer to delay practical application so as to analyse other's experiences with the technology prior to acting. The conceptual model is presented in figure 1.

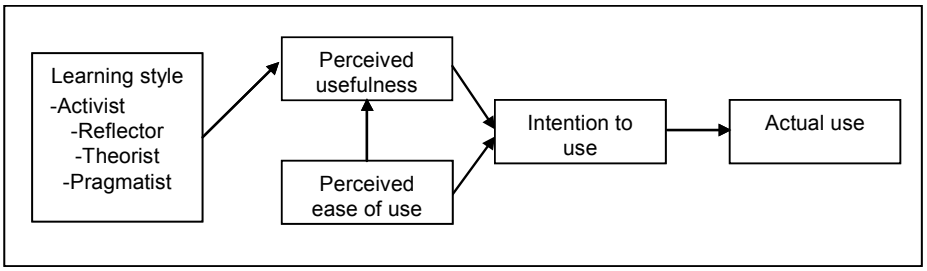

Figure 1. The Conceptual Model

Statement of Hypotheses

In the light of the above discussion, it is expected that the design of a class web site will influence its appropriation by students. In other words, acceptance will be enhanced when there is an appropriate match between learning style and the design of web services. The theoretical proposition is that students rated highly on the activist or pragmatist dimensions will view the use of class web-based services as more useful than students rated highly on the theorist or reflector dimension. The hypothesis to be tested is stated below.

> *Activist and pragmatist learning styles will have a more positive direct effect on the perceived usefulness of class web services than reflector and theorist learning styles.*

The Empirical Study

The Sample

The sample consisted of 57 undergraduate French business school students pursuing a two-month course in e-business and information technology management. The sample consisted only of students in this specialisation and, therefore, was non-random. Questionnaires were distributed and completed in class following a short presentation of the project's objectives. To ensure confidentiality of responses, personal information was not required. 49 students completed and returned useable questionnaires.

The average age was 23 with 5 years experience with the Web at the time of the study. The majority of the subjects had Internet access from home as well as from school premises and had experience with a number (on average 6.49) software packages.

The course was supported by a web site comprising a total of 10 services: course news, syllabus download, FAQ, lecture notes download, bulletin boards, course programme, groupware, curriculum vitae, student evaluations, and the possibility to modify personal information such as password. Use was of the web site was facultative and students could follow the course without using the web site.

Measures

Eight variables were measured in the questionnaire - four learning styles, perceived ease of use (PEU), perceived usefulness (PU), intention to use (INTENT) and actual use (USE) of the target learning support service. PEU, PU, INTENT and USE where measured for administrative, collaborative and class preparation web services. Table 1 provides descriptive statistics and the zero-order correlation matrix for the variables measured.

Table 1. Descriptive Statistics and Intercorrelations of the Variables at Test

		Range	Min	Max	Mean	S.D.	1	2	3	4	5	6	7	8
	All target technologies													
1	Activist	12-84	39	78	61.51	9.10	1.00							
2	Reflector	12-84	38	83	63.57	10.89	-.11	1.00						
3	Pragmatist	12-84	40	80	64.34	8.76	.59**	.24	1.00					
4	Theorist	12-84	40	83	59.34	9.38	-.03	.72**	.41**	1.00				
	Web-based administrative services													
5	PU	6-42	21	42	34.30	5.13	.25	.13	.36*	.23	1.00			
6	PEU	3-21	14	21	19.02	1.01	.09	.02	.09	-.07	.59*	1.00		
7	INTENT	1-7	1	7	6.17	1.54	.06	.34*	.18	.41**	.30*	-.11	1.00	
8	USE	1-6	2	6	4.06	1.03	.01	.16	.05	.13	.19	.22	.32*	1.00
	Web-based collaborative services													
5	PU	6-42	9	42	27.47	8.77	.16	.22	.35*	.23	1.00			
6	PEU	3-21	7	28	22.55	4.79	.22	.06	.31*	.12	.50*	1.00		
7	INTENT	1-7	1	7	5.15	1.61	.14	-.02	.28	.19	.69*	.52*	1.00	
8	USE	1-6	1	6	1.81	1.15	.19	.17	.27	.31*	.34*	.24	.41**	1.00
	Web-based class preparation services													
5	PU	6-42	18	42	35.32	6.32	.25	.16	.24	.01	1.00			
6	PEU	3-21	6	28	22.23	5.75	.29	.12	.43**	.19	.23	1.00		
7	INTENT	1-7	3	7	6.15	1.06	.28	-.15	.11	-.28	.38*	.07	1.00	
8	USE	1-6	1	5	1.79	.83	.04	.10	.14	.21	.28	.24	.23	1.00

** Significant at .05 level
*** Significant at .01 level

Learning Styles

Learning styles were measured based on Honey and Mumford's (1992) typology and using an instrument abridged and translated into French by Chevrier et al (2000). Students were presented with a question to which they had to respond their level of agreement on a 7-point likert-type scale. The Cronbach (1951) coefficient alpha statistics obtained for the twenty item measures of Activist, Reflector, Pragmatist and Theorist were 0.71, 0.85, 0.81 and 0.79 respectively, indicating that the items are a reasonable measure of the four dimensions.

Following Allinson and Hayes (1988), the internal structure of the LSQ was verified through principal components analysis, with a focus on the fours subscales rather than separate test items. The results are shown in Table 2.

Table 2. Loadings of Abridged Learning Styles Questionnaire Subscales on Two Factors after Varimax Rotation in Three Iterations

	Analysis	Action
Subscale		
Activist	-0.01	0.93
Reflector	0.91	0.02
Theorist	0.79	0.45
Pragmatist	0.15	0.92
Percentage of variance explained	53.8	30.9

Two factors explaining over 85 percent of variance emerged, one with positive loadings on Activist and Pragmatist, the other with positive loadings on Reflector and Theorist. These findings are similar to those of Allinson and Hayes (1988) who collapsed Honey and Mumford's (1992) four learning styles into two dimensions they labelled "Analysis" and "Action". An analyst would

"be expected to learn through the practical examination of ideas derived from objective study" (p.273) while a person high on the action dimension "might best learn through personal involvement in new experiences" (p.273).

The action dimension describes the hands-on approach of activists and pragmatists while the analysis dimension describes theorists and reflectors. The factors were respectively labelled "Action" and "Analysis" and the scores for each calculated.

Each score was associated with one of five preference categories ranging from very weak to very strong - based on Honey and Mumford's (1982) work with 1302 British managers and professionals.

Perceived ease of use.
The measurement of perceived ease of use was adapted from Adams, Nelson and Todd (1992) with the wording being changed to fit the specific technologies under study. The first item "Learning to operate [the target technology] would be easy for me" was deleted from ease-of-use scale for Web-based administrative services, as it did not correlate well with the other items. The Cronbach alpha statistic improved from 0.52 to 0.72. It was 0.88 and 0.93 for the ease-of-use measures of web-based class preparation and collaborative services respectively.

Perceived usefulness.
Perceived usefulness was measured based on Davis' (1989) original instrument requiring students to appreciate the difficulty of using the web site for their course work on a 7 point likert-type scale. The Cronbach alpha statistics were satisfactory 0.85, 0.96 and 0.91 for web-based administrative, class preparation and collaborative services.

Intention to use
Students self-rated their intention to use the target technology on a 7-point likert-type scale based on Adams, Nelson and Todd's (1992) measure.

Actual use
Actual use was reported by students along a 6-point likert-type scale ranging from "I have never used the [target technology]" to "I use the [target technology] several times per day".

Estimation Procedures and Results

The data were analysed using Amos 4.0 (Arbuckle and Wothke, 1999). Amos is a tool, similar to LISREL, that implements structural equation or causal modelling. Amos is especially suited to this type of analysis because it examines the fit of the entire model to the data, in addition to examining the significance of individual causal paths. Individual hypotheses can be examined within the context of the entire model as the effects of all correlations, shared variances and regressions are considered when the significance level and coefficient of a path are calculated (Gefen and Keil, 1998).

A model was estimated for each target technology, and the regression results are presented in Table 3. The effect of the action dimension on perceived usefulness is both positive and significant for each of the target technologies - web based administrative services ($p=0.001$), web-based collaborative services ($p=0.075$), and web-based class preparation ($p=0.021$). The analysis dimension has a weak positive effect on perceived usefulness of web based administrative services ($p=0.076$). Our expectation that activist and pragmatist learning styles ("Action") will have a more positive direct effect on the perceived usefulness of class web services than reflector and theorist learning styles ("Analyst") is supported.

Discussion, Limitations and Conclusions

Student learning styles have come to be viewed as a critical variable in the design and delivery of learning materials and the deployment of learning technologies. The educational technology literature to date has tended to focus on the impact of learning styles in the design and use of information technologies that significantly transform the learning environment, such as computer-based training or distance learning. This focus ignores the role of support technologies or electronic learning materials that, from a constructivist view, play an important role in the learning process. This paper extends existing research by shedding some light on the acceptance of support technologies in a more traditional class-room based learning environment. The results support prior literature which has argued that the effectiveness of educational technologies to the learning process is enhanced when they are designed and deployed to support learning style differences.

Table 3. Regression Results

	Web-based administrative services		Web-based groupware		Web-based class preparation	
	β	SE	β	SE	β	SE
Determinants of Perceived Usefulness						
Action	1.52***	.47	1.75*	.98	1.93**	.84
Analysis	.85*	.48	1.15	.97	.21	.79
Perceived Ease of Use	1.60***	.29	.77	.23***	.08	.17
Determinants of Perceived Ease of Use						
Action	.10	.24	1.10*	.60	2.03***	.68
Analysis	-.01	.24	.30	.62	.65	.69
Determinants of Intention to Use						
Perceived Usefulness	.17***	.05	.11***	.02	.07***	.02
Perceived Ease of Use	-.37***	.14	.08**	.04	-.01	.03
Determinants of Actual Use						
Intention to Use	.22**	.09	.30***	.10	.18	.11
χ^2	12.84		6.15		10.92	
Degrees of freedom	7		7		7	
Probablity	0.08		0.52		0.14	
Ajusted Goodness of Fit Index	0.77		0.85		0.80	

* Significant at .10 level
** Significant at .05 level
*** Significant at .01 level

These results should be interpreted in light of several limitations of the study. One is that the sample was small and non-random. Although there is nothing to suggest that this has introduced systematic bias, the use of a large random sample would increase confidence in the statistical techniques employed and enhance the generalizability of results.

There are also potential limitations with the instruments used to measure the variables. First, the two dimensional structure of Honey and Mumford's (1982) instrument used to measure learning styles requires further work. Second, the measurement of performance was based on self-ratings which may lack objectivity.

Further research extending the model developed here to take into account the role of peer-group (Venkatesh and Davis' (2000) "subjective norm") would provide additional insight into the design of web support services in an educational context.

Notwithstanding these potential limitations, the results of the study provide evidence of the significant role of learning styles on successful technology acceptance by students. At a time of "one-to-one" marketing and dynamic web site designs that identify and adapt to individual customers, it is maybe time to rethink learning support services for one-to-one learning.

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